THE WEATHER ELEMENTS

By P. C. DAY, Meteorologist in Charge of Division

PRESSURE AND WINDS

Low barometric pressure over the eastern and southern portions of the country and apparently embracing much of the North Atlantic was the marked feature of the weather during the month. This condition was induced mainly by the passage eastward of a number of cyclonic areas which originated over the Southwest and developed materially as they progressed eastward in latitudes lower than usual, reaching the coast as storms of importance.

A storm of this character was first charted on the morning of the 7th over the far Southwest and moved by slow stages eastward, without material precipitation, until the morning of the 9th, when it was apparently central south of the middle Gulf coast, and precipitation covered a wide area from the middle Plains southeastward to the east Gulf States, snows occurring over the northern portions of the precipitation area, and some heavy rains to the southward. By the following morning the cyclonic conditions had developed materially, with important centers of action in the Ohio Valley and off the South Atlantic coast. By the morning of the 11th the main center was over Delaware and eastern Maryland, where the pressure was only slightly above 29 inches. High winds prevailed along and near the coast, heavy rains were falling over portions of the Middle Atlantic States and some heavy snows for the season occurred in western Maryland and adjacent areas. This storm continued its northeasterly course with undiminished energy, and was south of the New England coast by the 12th and to southward of Newfoundland within the following 24 hours.

Another important cyclone moved into the west Gulf section on the morning of the 19th and by 8 a. m. of the 20th was central as a storm of considerable force over the middle Gulf States, attended by precipitation over a wide area from the middle and southern Plains eastward. During the night of the 19th–20th the pressure at points in the lower Mississippi Valley was the lowest of record for March.

The storm moved to the Chesapeake Bay region during the following 24 hours and thence eastward toward the Bermuda Islands.

The most important cyclone of the month was first observed as an area of falling pressure to westward of the Rocky Mountains on the morning of the 27th, and during the following 24 hours moved to the vicinity of Colorado where the barometer had fallen sharply. As this cyclone moved eastward it developed greatly in energy, and at 8 a. m. of the 29th was central over Iowa as a storm of great severity with unusually deep depression of the barometer, the readings at the center falling below 29 inches, which at some points was the lowest observed in any month and at others the lowest ever observed in March. Heavy snows fell over portions of the northern and northwestern limits of the storm area as it moved eastward, and high winds caused much drifting; the snow was particularly heavy over a considerable area from South Dakota to Wisconsin, the depths ranging up to 2 feet or more at points in central Minnesota. Farther south frozen rain and wet snow caused damage to overhead wire systems, the loss being confined largely to sections of northern Iowa and southern Wisconsin. During the 30th and 31st the storm moved to the lower St. Lawrence Valley, but it diminished greatly after passing the Great Lakes region. Precipitation from this storm was widespread, covering nearly all districts from the Great Plains eastward, and it was heavy in many sections of the Ohio and middle Mississippi Valleys.

The month was remarkably free from anticyclones, in fact no important high pressure area traversed any extensive region, although southern extensions from a rather permanent anticyclone that appeared to persist during the greater part of the month over central Canada, were projected into the districts between the Rocky Mountains and Great Lakes on a number of dates.

The pressure distribution as a whole was materially different from that usually present in March. Over the districts from the Mississippi River eastward the average pressure was below normal, becoming markedly so over the more eastern districts where the depression was a quarter of an inch or more, and more or less persistent during the entire month. The average pressure was likewise lower than normal over the Plateau and southern Rocky Mountains and throughout the entire south.

A small area along the coast from northern California to Washington had pressure for the month slightly higher than normal and from Nebraska and Wyoming northward into Canada the average pressure was likewise greater than normal.

Compared with the preceding month the pressure was lower in all parts of the country, and while this is the normal condition, the decreases were usually much greater than normal, this being particularly true over the Plateau region, the New England States and the Canadian Maritime Provinces.

The sharp falling off in the average pressure from the interior of Canada to the southeastward, southward, and southwestward, materially favored air drainage in southerly directions, and the prevailing winds for the month were mainly from northerly points over all parts of the country from the Rocky Mountains eastward.

The main high winds of the month were associated with the cyclone that moved northward along the Atlantic coast on the 11th and 12th, and with that moving from the Middle Plains northeastward to the Great Lakes on the 28th to 30th. During the passage of this latter storm unusually high winds were observed generally at points within its influence, some stations reporting the highest velocities ever observed, and in other cases local tornadoes occurred, particularly in Oklahoma, where at and in the vicinity of Shawnee eight or more persons were killed and much property damaged. Local tornadoes, but without severe damage, were reported from points in Illinois and Missouri.

A list of the important storms of the month appears at the end of this section.

TEMPERATURE

Temperature conditions during March, 1924, on the whole were more typical of winter than of spring, particularly over the southern and western districts where coolness was almost continuous and the average temperatures for the entire month were in many cases lower than those of February preceding. On the other hand, over the northern sections from the upper Missouri Valley to the Great Lakes and Northeastern States, and generally over the Canadian Provinces east of the Rocky Mountains, the temperature characteristics were more springlike.

As in the preceding month there was a noticeable absence of important 24-hour changes in temperature; in fact, over the northern sections and in Canada practically no change as great as 20° in 24 hours occurred during the entire month, where usually such variations are frequent. In the central and southern districts there were several such, though confined mainly to small areas.

Considering the temperature by weekly periods the week ending March 4 had averages on the whole above the normal in all districts, save from the lower Rio Grande Valley eastward, the week being particularly warm over the central and northern districts between the Rocky Mountains and the Great Lakes and Ohio Valley.

The week covering the period March 4 to 11 was mainly cold, only small areas from the vicinity of the Great Lakes to the Northeastern States and over the Pacific coast sections having average temperatures above normal. No unusual cold occurred during the week, but temperatures were continuously low over the greater part of the country, and freezing extended southward to the Gulf coast and into northern Florida.

For the 7-day period ending the 18th, the weather continued cold over nearly all parts of the country, the average temperatures for the period ranging from 10° to 18° below the normal over a large area extending from the central Rocky Mountains southeastward to the East Gulf and South Atlantic States. Freezing temperatures again reached well toward the Gulf coast, and they were frequent in the interior districts. The following 7-day period continued cold throughout over much of the territory having such conditions during several preceding weeks, though a small area from the Dakotas eastward to New England had temperatures above normal.

The last week of the month continued cold generally over the central valleys and western districts, the temperatures during this period continuing particularly low over the Rocky Mountain and Plateau districts, as had been the case throughout practically all the preceding weeks.

The principal warm periods of the month were on the 1st from North Dakota to Idaho and generally over the Plateau region, and from the 27th to 31st over the greater part of the remainder of the country.

The highest recorded temperature, 104°, occurred in Texas, though in most of the Southern States 90° was not reached, and in some of the Northern States the maximum temperatures did not reach 60°.

The coldest periods of the month ranged between the 1st and 31st and no large area had its lowest temperatures on any single date. Temperatures below zero occurred over most northern districts and generally in the mountains of the West; the lowest observed, −26°, was reported from two points in Colorado.

Although much cold weather was the rule, yet no extremely low temperature records were broken.

The averages for the month were below normal over the greater part of the country, the month being particularly cold over the central and southern districts. Over a large area from the middle and southern Plateau region eastward to the Gulf States the month was either the coldest or among the coldest of record for March. Along the northern border, however, from eastern Montana to New England and southward to the Chesapeake Bay region, the month was warmer than normal, and similar conditions prevailed over Canada, the excesses being greatest over the more northern districts, where the month was far warmer than usual for March.

PRECIPITATION

Over the greater part of the country from the Mississippi Valley eastward precipitation was mainly less than is usually received in March, although there was a considerable area from Iowa and Minnesota southeastward to the Ohio Valley and Middle Atlantic States with amounts somewhat above normal, and portions of northern and central Florida had heavy falls. In the Great Plains and Rocky Mountains the precipitation was mainly above normal, and the southern Plateau and southern California likewise had precipitation above normal, while in the far Northwest there was a general deficiency.

In the Rocky Mountain regions much snowy weather prevailed, and in most other sections to the eastward the precipitation, though frequently deficient as compared with the average fall, was well distributed through the month, although in portions of New York there was little till near the end of the month, and portions of southern Florida had little or none, although the northern and central portions of that State had some heavy amounts.

In California the severe drought that had persisted for so many months was partially broken, particularly in the southern portions where the total fall was somewhat above normal.

In Oregon the precipitation was scanty for a spring month, and on the whole it was among the driest of record for March, and there was a large deficiency in the adjacent State of Washington.

The greatest monthly precipitation, 13.70 inches, was reported from northern Florida, and none was observed at a point in the southern part of the same State. At two points in Texas no precipitation was observed during the month, and none fell at a point in eastern Washington.

The precipitation attending the storm of the 28th-30th was the most widespread of the month and heavy falls were recorded over large areas. In western Maryland and adjacent portions of other States, the heavy rains, in connection with melting snow which had already swollen the streams in that vicinity, caused one of the worst floods known in portions of the upper Potomac River, a full account of which will be found in another section of this issue.

SNOWFALL

There was a wide distribution of snow during the month, and some unusual falls were reported.

About the 13th to 14th heavy snows occurred over portions of Alabama and adjacent States amounting to nearly a foot in some sections, and at Montgomery a depth of nearly an inch and one-half was the first measurable snowfall ever observed at that place in March.

In the Southern Plains region the month brought unusually heavy snowfall, notably in western Kansas and portions of adjacent States, where all records of snowfall in March were broken, the total fall ranging up to 3 or 4 feet and in one case a total of more than 5 feet was measured. Heavy snows also fell over a wide area during the severe storm of the 28th–30th, the greatest depths ranging up to two feet or more, occurring from the middle plains region northeastward over Iowa, northern Missouri, and central and southern Minnesota to the upper Lakes.

High winds attending the snowfall caused much drifting and interference with traffic and to the southward of the heavy snow area more or less ice formed on overhead wire systems and much loss to these and delay in communication resulted, particularly in southern Wisconsin and portions of Iowa.

In the western districts there was much snowfall in the Rocky Mountain region and the outlook for a good supply of water for the coming summer was greatly improved; also in most of the Plateau region there was much improvement in the outlook, although over the northern portions the stored snow is still less than normal.

In the mountains of California there was considerable snow during the month, but the seasonal fall is still far below the normal and the indications are that the water shortage for irrigation and power purposes will be serious.

In connection with the general rain and snowstorm of the 27th to 30th there were many reports of the deposit of a brownish substance in connection with both the rain and snow, over wide areas, but particularly in the upper Mississippi Valley and adjacent districts. In this connection it is interesting to note that on the 27th and 28th there were high winds in many portions of New Mexico, much plowed land was badly drifted, and in some sections of the State the dust storms were reported as the worst ever known.

RELATIVE HUMIDITY

The moisture conditions existing in the atmosphere during March, as indicated by the average relative humidity, were mainly not far from the average, except for a rather marked excess over the Great Plains, where much cold, inclement weather prevailed, and a general deficiency in the far western sections, where the weather was warmer and there was mainly a considerable deficiency in the precipitation.

SEVERE LOCAL STORMS, MARCH, 1924

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path (yards)	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Apalachicola, Fla	9	4:35–7:05 a. m.			$1,000	Wind	Fishing boats damaged	Official, U. S. Weather Bureau.
Maryland, southern Pennsylvania, and northern Virginia.	10–11			2	1,000,000	High winds and heavy fall of moist snow.	Telephone, telegraph, and lighting systems crippled; about 2,500 poles blown down; electric schedules interrupted; trees injured.	Official, U. S. Weather Bureau; Sun (Baltimore, Md.)
New York, N. Y., and adjacent seacoast.	10–11					Gale and rain	Shipping paralyzed; wire communication interfered with and some property damage.	Morning Sun (Binghamton, N. Y.).
Richmond, Va	10–11					Wind and snow	Communication lines badly crippled; traffic delayed.	Official, U. S. Weather Bureau; News Leader (Richmond, Va.).
Atlantic City, N. J	10–11					Wind, rain, and snow.	No damage reported	Official, U. S. Weather Bureau.
Providence, R. I	11–12				800,000	Wind and snow	Telephone and light companies suffer heavy loss; car service tied up; other property damage.	Do.
Harper, Montgomery, and Elk Counties, Kans.	28				5,000–10,000	Series of 5 tornadoes.	Farm buildings, fences, wires, and some stock cars damaged.	Do.
Ludington, Mich	28–29					Wind, rain, sleet, and snow.	Damage principally to overhead wires	Do.
Oklahoma	28–29			8	841,000	Tornadoes and high winds.	Tornadoes at Noble and Shawnee, resulting in 68 injured. Severe winds in other parts of State, especially Oklahoma City and southern part of Tillman County.	Do.
Illinois	28–29					Winds	Residences and other buildings damaged; trees, fences and poles destroyed; orchards injured. At Alton tornadic wind injured 1 person.	Do.
Missouri	28–29			3	204,000	Tornadoes and winds.	Orchard trees uprooted; wires broken; stock killed, and some buildings blown down. One tornado at Oregon, another traversed New Madrid, Scott, Bollinger, and Girardeau Counties causing much property damage.	Do.
McCracken and Ballard Counties, also cities of Newport and Covington, Ky.	28–29					High winds	Towns of Lamont, Grahamville, and Maxon suffered severely in loss of buildings; extreme damage in vicinity of Newport and Covington.	Do.
Southwest Arkansas and Northwest Louisiana.	28–29				250,000	do	Heavy damage in gas and oil fields	Do.
West Texas	28–29					Wind and sand	Crops, buildings, and communication lines considerably damaged; 3 persons injured near Vernon.	Do.
Southeast portion of Wisconsin.	28–30				1,000,000	Sleet, snow, and wind.	Serious damage to trees and overhead wire systems; highways blocked and railway and interurban traffic delayed.	Do.
Evansville, Ind	29					High winds	Considerable damage throughout the city	Do.
Sullivan County, Ind	29	a. m.			200,000	Winds	General damage done; 5 persons injured	Star (Terre Haute, Ind.).
Terre Haute, Ind	29	9:45 a. m.			5,000–6,000	do	Interurban car service delayed; wires and poles damaged.	Official, U. S. Weather Bureau.
Cincinnati, Ohio	29	a. m.				do	Considerable damage in various parts of the city	Do.

551.515 (73)

STORMS AND WEATHER WARNINGS

By EDWARD H. BOWIE, Supervising Forecaster

From its beginning to its end the month of March gave winter cyclone types, at times of pronounced intensity, over practically all parts of the country. It is noteworthy that during much of the month there was a suppression of the rather common type of cyclone that moves along the northern border after having passed into British Columbia from the North Pacific Ocean or Alaska. Hence, cyclones which crossed the country did so in low latitudes, and, as is the case in practically all instances, these disturbances were attended by widespread precipitation, much of it in the form of snow along and to the north of the track of the center of the cyclones and were also attended by high winds and by the carrying far southward of cold air by the local wind circulations as the cyclones passed eastward.

One naturally asks why March of 1924 should conform so closely to typical February cyclonic types rather than to types characteristic of early spring? Why did the cyclones move in low rather than high altitudes, and the month turn out to be one of much cloudiness, unusual storminess, and cold weather? Unquestionably the immediate cause is seen in the phenomenally low barometric pressure which persisted throughout the month over much of the North Atlantic Ocean, which permitted nearly all cyclones to reach the Atlantic coast south of Cape Cod, whereas under normal pressure conditions they pass off the continent by way of the St. Lawrence Valley. During March, 1924, the upper air winds over the United States east of the Rocky Mountains were commonly observed from the West and Northwest, whereas, ordinarily they are from the West or Southwest a considerable part of the time. Moreover,